DOCUMENT RESUME

ED 152 568 SE 024 113

AUTHOR Bliss, Richard B.
TITLE A Comparison of Two Approaches to the Teaching of Origins of Living Things to High School Biology Students in Racine, Wisconsin.
PUB DATE 78
NOTE 125p.; Ed.D. Dissertation, University of Sarasota; Not available in hard copy due to marginal legibility of original document

EDRS PRICE MF-$0.83 Plus Postage. HC Not Available from EDRS.
DESCRIPTORS *Biology; *Critical Thinking; Doctoral Theses; Educational Research; *Evolution; Science Education; *Scientific Concepts; Secondary Education; *Secondary School Science
IDENTIFIERS *Research Reports

ABSTRACT

This study was conducted in order to assess the difference in concept development and principle learning between high school biology students studying the origin of life from a two-model approach (evolution and creation) and those using the single-model approach of evolution only. The pre-test, post-test control group design using a criterion referenced instrument showed that the experimental group (two-model approach) did significantly better in all areas than did the control group. The experimental group also did significantly better on evolution items than the control group did. In addition to this, the overall data seem to suggest that the experimental group was more willing to make critical judgments in regard to origins and change their views when new data came forth than were those studying evolution only. Thus, it appears that this new approach to the study of origins will not only stimulate an interest in science, and possibly social sciences, but will also place the student in a very desirable and challenging position where value judgments, interpretations of data, formulations of questions and hypothesis, etc., will become manifest. (Author/BB)

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A Comparison of Two Approaches to the Teaching of Origins of Living Things to High School Biology Students in Racine, Wisconsin

by

Richard B. Bliss

SE 024 113

A COMPARISON OF TWO APPROACHES TO THE TEACHING OF ORIGINS OF LIVING THINGS TO HIGH SCHOOL BIOLOGY STUDENTS IN RACINE, WISCONSIN

by

Richard B. Bliss

Doctoral Committee:

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Chairman

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Submitted in partial fulfillment of the requirements for the Degree of Doctor of Education in the University of Sarasota
1978

ACKNOWLEDGMENTS

There comes the time when all the writing is done and the author sits back to contemplate the deed. The question, could I have done it without these, comes to mind. My reflections bring me back to the Unified School District in Racine, Wisconsin with all of its fine teachers, parents and students. I reflect on the quality of instruction needed to fulfill this research task, and the importance of this work to young people who are searching for answers to how life and this universe came to be. Then, my thoughts turn to teachers like Joan Bennett, Darrell Murray, Erv Forgy, and John Sullivan. They performed their roles in this study and made with a high degree of professional skill a reliable research project come to fruition.

I am thankful to Jane Gordon, Director of Science, as I reflect on the administrative duties that are always so helpful in making a study move along smoothly within a district. In addition, few of us qualify as expert statisticians and thus when that time comes when all the data must be correlated and integrated into the study we find ourselves sitting at the experts' feet looking for counsel and direction. In this respect I give thanks to R & D Director, Dr. Orvil Tordahl and his faithful staff members, Dee Jensen and Bob

Jacobs. Without their help this study would not have had the statistical depth and quality it now has.

Finally and foremost in my acknowledgments must come the faithfulness of my wife, Lolly. She stood by me through all the academic trivia of the years of graduate work that finally led to a doctorate. She upheld me with her prayers and deep devotion during times when I needed it most. Without her help, guidance and love, this would never have come to pass.

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Chapter I

THE PROBLEM

Introduction

In recent years, the whole concept of science and social science instruction seems to be centered around the development of process skills and inquiry techniques. Researchers have gathered data that show many satisfying by-products in essential areas of reading, language arts, mathematics and others. Perhaps the most often quoted advantages are those related to decision making and logical thought processes.

The learning of scientific concepts through inquiry techniques and process skills seems to have several advantages. Research, as well as intuition, seems to indicate that this approach would tend to place the bulk of the learning responsibility upon the student and would, in effect, make him the prime decision maker. The teacher, on the other hand, is placed in a role of an instructional guide, leading his students through objective decision making sequences, the development of a logical frame of reference and a realization of self worth.

Inquiry, once developed by the student as a functional skill, can be applied to any changing situation. A student can now apply rational thought with cognitive tools, and thus expand his framework for knowledge and understanding.

> It is. . .clear that understanding of methods helps solve the problem of surfeit in knowledge. If one possesses the tools of inquiry he is not in need of a large store of accumulated knowledge. He is able to adapt and improvise to meet the needs of particular situations and is less dependent upon the results of others. The methods of a discipline in effect contain all the particular findings that result from inquiry. In that sense knowledge of methods is a kind of surrogate for everything that can be discovered by applying them. (Phenix, 1964, p. 333).

There seems to be adequate empirical data to support the idea that inquiry is significant in the development of mental structures. These mental structures, in turn, may be the key to learning. John W. Renner and Anton E. Lawson have studied these views and summarize some of this thinking:

> According to Piaget a person is unable to perceive things until his mind has a structure which enables its perception. Without the development of a mental structure things which seem obvious to an adult, such as the difference between a key and a book, a square and a circle, are simply not perceived by beginners. But this leads us to a fundamental problem. If learning is the building or rebuilding of mental structures, and if structures are needed in order to perceive and learn and are not derived from simply copying the external world, then where did they come from? . . .Piaget's view is that the development of

> structures derives from a dynamic interaction of the organism and the environment which he calls equilibration. (1973, p. 166).

While educators and others interested in education often differ in their opinions of what modifications should be made in various established instructional techniques, few will deny that important objectives in education are to give students adequate intellectual and mechanical skills that will enable them to make a constructive contribution to society. Among these skills are those of decision making and the application of logical thought processes. The skills are clearly stated in the National Science Teacher's Guidelines to Science Education. These guidelines imply that the major goal of science education is to develop scientifically literate and personally concerned individuals with a high competence for rational thought and action. These goals are based on the belief that achieving scientific literacy involves the development of attitudes, process skills, and concepts necessary to meet the more general goals of all education, such as: learning how to learn, how to attack new problems, how to acquire new knowledge; using rational processes; building competence in basic skills; developing intellectual and vocational competence; exploring values in new experiences; understanding concepts and generalizations; learning to live harmoniously within the biosphere.

> Above all, the school must develop in the individual an ability to learn under his own initiative and an abiding interest in doing so. The goal of science education should be to develop scientifically literate citizens with the necessary intellectual resources, values, attitudes, and inquiry skills to promote the development of man as a rational human being. (National Science Teachers Association, 1971, p. 47).

The National Science Teachers Association carries the general goals of science education much further into the process and inquiry skills as it goes on to describe what a scientifically literate person is like. It says that the scientifically literate person is, in general, a person who uses science concepts, processes, skills (observation, experimentation, etc.) and values (respect for logic, search for data, etc.) in everyday life. This person is also portrayed as one who understands that scientific knowledge depends upon the process of inquiry as well as concepts. Above all, the literate person in science will be able to discern between scientific evidence and personal opinion, between facts and theory, and is one who continues to inquire throughout his scientific life. While this is not the primary thrust of the study, it is nevertheless inherent within the instructional techniques of both the experimental and the control groups in the study.

Perhaps some of the strongest encouragement to apply inquiry skills wherever possible is in the affective or value-oriented domain.

It is important for schools to realize the great opportunities that science has offered by promoting values on which it is based. The values, as stated by the Education Policies Commission and which underlie science are: longing to know and to understand; questioning of all things; search for data and their meaning; demand for verification; respect for logic; consideration of premises; consideration of consequences.

While these values do not resemble traditional values, they nevertheless are guidelines for science education and an important by-product in this study. By their very nature one can see that the desired values may not be communicated effectively by indoctrination; therefore, one can conclude that value expression must come from a freedom to search and to draw independent conclusions from the data retrieved. It is within this framework or reason that this study is directed.

The present study is undertaken to compare the educational value of presenting a two-model approach to the origin of life -- evolution and creation -- with instruction in a single model (evolution) only. The question that will be pursued in the two-model approach will be: "Which model (creation or evolution) do these data seem to fit best?" The question in the single-model approach is centered around evolution only. In both respects, inquiry techniques

are used and the greater concern of the teacher in this approach is whether the student is using accepted science skills and is applying objective logic.

Statement of the Problem

The problem addressed here is this: When groups of students studying the origins of living things from an evolution model only are compared with students taught from a two-model approach (evolution and creation), do differences in cognitive skills and concept development appear?

Background of the Problem

In the last twenty years a significant number of scientists have become disenchanted with the evolutionary model as an explanation for the present existence of all life and life processes. They reject this concept while holding to the idea that creation is a better scientific model. "The creation model postulates that all the basic systems of nature, including elements, stars, planets, life, and the major kinds of organisms, including man, were created fully-developed by supernatural creative processes..." (Morris, 1975, p. 9).

The Creation Research Society, 2717 Cranbrook Road, Ann Arbor, Michigan, 48104, and the Institute for Creation Research

2716 Madison Avenue, San Diego, California, 92116, were both formed to orient scientific research around the point of view of a creation model. In recent years significant studies have been reported and cited in the Creation Research Quarterly in all fields of science. Creationists have also brought forth significant alternatives to interpretations of established data that have in the past been generally used to support the evolution model. They have substantiated their arguments in numerous public debates with committed evolutionary scientists. In addition, books, position papers, conferences and lectures have come forth from scientists, educators and philosophers, all showing their distinctive interpretation of the evolution and creation models. The question has, in fact, brought forth new excitement to the various concepts relating to the origin of our universe and living things.

In contrast to the creation model, the evolution model explains the origin and development of all things by natural laws and processes that are in operation at this time. Evolutionists, as strictly defined, reject the concept of a world view based upon a supernatural creator. In the main, they would reject creationism as being a religion and propose that evolution is the only scientific model. The evolutionist maintains that given enough time, the natural mechanistic processes, such as adaptation and

natural selection, would have time to produce the diverse forms of life that are before us today. Given eons of time, the improbable becomes probable.

> Most enlightened persons now accept as fact that everything in the cosmos -- from heavenly bodies to human beings -- has developed and continues to develop through evolutionary processes. (Dubos, 1965, p. 6)

> Evolution comprises all the stages of the development of the universe: the cosmic, biological, and human or cultural developments. . . Life is a product of the evolution of inorganic nature, and man is a product of the evolution of life. (Dobzhansky, 1967, p. 409)

> Evolution in the extended sense can be defined as a directional and essentially irreversible process occurring in time, which in its course gives rise to an increase of variety and an increasingly high level of organization in its products. Our present knowledge indeed forces us to the view that the whole of reality is evolution -- a single process of self-transformation. (Huxley, 1955, p. 213)

> Biological evolution can, however, be explained without recourse to a Creator or a planning agent external to the organisms themselves. There is no evidence, either, of a vital force or immanent energy directing the evolutionary process toward the production of specified kinds of organisms. (Ayala, 1968, p. 213)

> Man stands alone in the universe, a unique product of a long, unconscious, impersonal, material process with unique understanding and potentialities. These he owes to no one but himself, and it is to himself that he is responsible. He is not the creature of uncontrollable and undeterminable forces, but his own master. He can and must decide and manage his own destiny. (Simpson, 1953, p. 157)

In addition to the extreme position taken by certain men of stature we find another group that prefers to take a position that neither evolution nor creation can be considered a scientific theory for both fail to establish a valid test of falsification or disproof.

> Our theory of evolution has become. . .one which cannot be refuted by any possible observations. It is thus outside of empirical science, but not necessarily false. No one can think of ways in which to test it. . .(Evolutionary ideas) have become part of an evolutionary dogma accepted by most of us as part of our training." (Ehrlich and Birch, 1967, p. 352)

> There are philosophical or methodological objections to evolutionary theory. . . .It is too difficult to imagine or envisage an evolutionary episode which could not be explained by the formulae of neo-Darwinism." (Medawar, 1967 p. xi)

The philosophical waters seem to be muddied and the models seem to be emerging as faith models in the minds of men. In the historical sciences, problems simply cannot be resolved by crucial experiments. In addition, the only two general models which are relevant to the origin of living things are either evolution by internal self-transforming processes or creation by an external force that created all things. The alternatives, or submodels, under both of these general paradigms are to invoke men from outer space, created or evolved, or some other theistic or deistic submodel. Ultimately, however, one gets back to the general model.

Was life created or did it evolve? In this respect, then, educators can deal with the subject of evolution and creation from a nonsectarian point of view. It is desirable, even conditional, that the many submodels for evolution and creation be proscribed in the science classroom, for it is at this point that science teachers could find themselves departing from the teaching of science and entering the realm of fiction. Pedagogically, the problem can be resolved only when an inquiry setting prevails and students are offered the question in relation to two general models: "Which model do these data seem to fit best?"

Need for the Study

The present study is an attempt to evaluate the cognitive effects, as measured by a face-validated criterion-referenced pre-and post-test, of a two-model approach to origins of living things when implemented in a high school biology classroom.

The pattern of development surrounding the question of origins seems to indicate that an approach to science education establishing two philosophical models as alternatives is in keeping with good instructional techniques and has the added advantage of making students aware of conflicts in scientific thought and philosophy. This study was proposed because of the need to estab-

lish data related to instruction in the origin of life. Since a study with two models has never been done, one could conclude that the data would be very valuable to science educators seeking to build on current curricular practices. The question "Which model do these data seem to fit best?" seems to be a reasonable question that can lead toward logical thought processes and decision making skills. This question seems to be relevant to curriculum needs and can easily be placed into the context of inquiry. From the standpoint of the layman, high school student, teacher and college student, the need for such a two-model approach as a reasonable compromise to questions relating to either model seems to be evident.

Formal debates among scientists have been held on major campuses throughout the United States, Canada and other countries. Significantly, these debates, of which there have been over sixty, seem to indicate that there is not only a polarization of viewpoints among scientists but also a great deal of interest among students relating to the question of the origin of living things. Creationist speakers with scientific expertise are emerging and seem to be in great demand. An estimated number of talks and lectures by scientists from the Institute for Creation

Research alone is over one thousand during the last five years. During 1975 alone, for example, Dr. Duane Gish and Dr. Henry Morris have spoken or debated on over 60 college and university campuses, not to mention numerous public schools, science organizations and teachers associations. It is estimated that over 30,000 college students have heard one or more of these creationist messages during 1975:

> . . . .Some of the nation's leading universities--University of California (Berkeley, Los Angeles, San Diego), Louisiana State University, University of Kansas, University of Wisconsin (Madison, Milwaukee, Oshkosh), University of North Carolina, Tulane University, Oregon University, Texas Tech., University of Missouri, Kansas State, University of Minnesota, Virginia Polytech, Colorado State, University of Texas, University of Tennessee, Auburn University, University of Florida, Penn State and many others. . . .(Acts and Facts, 1975, Vol. 4, No. 10)

These activities are related only to those which were carried out by members of the Institute for Creation Research staff. It should also be reported that many other scientists have been speaking and writing in behalf of creation throughout the United States.

Assumptions

The following assumptions will be made throughout this study:

1. This study will assume that a teacher can do justice to a theoretical model which he may or may not believe. This assumption is further strengthened by the fact that all teachers in the experimental group have been trained by the researcher in the administration of a two-model approach to origins.

2. This study will assume that both models for origins, the creation model and the evolution model, are valid scientific models and not scientific theories.

3. This study will assume that all teachers involved are competent instructors in inquiry.

Definitions

Concept - The word concept has a variety of meanings. For the purpose of this study this word will be used in the same context as it was used in the Benjamin Thompson study (technical report No. 245 - doctoral dissertation) which used the following as a definition for the term:

> . . . . a summary of essential characteristics of a group of ideas and/or facts that epitomize important common features or factors from a larger number of ideas (Pella, 1966).

Model -The word model will be defined as a philosophical frame of reference, a paradigm, which is not provable by empirical means but which may be used to correlate and explain data.

Evolution - The word evolution will always be used in the familiar sense: . . . . that existing types of animals and plants have developed from previously existing kinds and that all life arose from nonlife at some point in time.

Creation - The word creation will refer to the work of natural creator who designed all the basic systems of nature.

> . . . . The creation model postulates that all the basic systems of nature, including elements, stars, planets, life, and the major kinds of organisms, including man, were created fully developed by super-natural creative processes during a primeval period of special creation . . . . (Morris, 1975).

Critical Thought (frame of reference) - The term critical thought, as used in this study, will always refer to being willing to challenge or analyze data from a new perspective.

Cognitive: The word cognitive, as used in this study, will always refer to the mental process by which knowledge is acquired -- the use of data to enhance knowledge.

Hypotheses

The statements of the null hypotheses in this study are as follows:

1. H_O: There is no significant difference in concept development and cognitive skills between students being taught from a two-model approach and those being taught from a single-model approach (evolution only).

2. H_O: There is no significant difference between boys and girls when both are instructed in concepts of origins from a two-model appraoch; neither will develop significantly better cognitive skills related to origins of living things than those instructed from a single-model approach.

3. H_O: There is no significant difference between low IQ students, 79 through and including 102, and middle IQ students, 103 through and including 112, when both are instructed in concepts of origins from a two-model approach; neither will develop significantly better cognitive skills related to origins of life than those instructed from a single-model approach.

4. H_O: There is no significant difference between low IQ students, 79 through and including 102, and high IQ students, 113 through and including 146, when both are instructed in concepts of origins from a two-model approach; neither will develop significantly better cognitive skills related to origins of living things than those instructed from a single-model approach.

5. H_O: There is no significant difference between middle IQ students, 103 through and including 112, and high IQ students, 113 through and including 146, when both are instructed in concepts of origins from a two-model approach; neither will develop significantly better cognitive skills related to origins of living things than those instructed from a single-model approach.

6. H_O: There is no significant difference in Likert preference and concept development and cognitive skills between those taught from a two-model approach and those taught from a single-model approach.

7. H_O: There is no significant difference in Likert preference and low IQ and middle IQ students, between those taught from a two-model approach and those taught from a single-model approach.

8. H_O: There is no significant difference in Likert preference between low IQ and high IQ students, between those taught from a two-model approach and those taught from a single-model approach.

9. H_O: There is no significant difference in Likert preference between middle IQ and high IQ students, between those taught from a two-model approach and those taught from a single-model approach.

Delimitations

The present study will not deal with the possible philosophical ramifications of either the evolution or the creation model. It will not deal with all of the possible submodels such as atheistic, deistic, men from outer space, etc. that could be developed from the evolution and the creation models. The study will confine itself to a student's perception of whichever model the data seem to fit best in the two-model experimental group and the mechanisms of evolution only in the control group. Both models, evolution and creation, will be dealt with as defined in this study.

Chapter II

A REVIEW OF RELATED LITERATURE AND RESEARCH

Introduction

An important aspect of this study is to attempt to identify appropriate instructional techniques that would strengthen the cognitive or factual as well as the affective or value oriented learning of students in our high school classrooms. This, of course, implies a thorough study of past research as well as historical influences that might shed light upon students', parents', and teachers' reactions to the topic. Few studies have been made that reflect any of this information in a statistical sense. This chapter will, of necessity, draw heavily from these few pertinent sources in order to show a perspective of these data.

Early Influence in Science Curriculum Construction

Most people believe that the beginnings of evolutionary thinking as a world view in education came upon the intellectual scene with Charles Darwin; however, the real impact of evolutionary thought in education came shortly after World War II. A

massive rethinking in science education began with the National Supervisors of Science Education and was presented in the 31st yearbook in 1959 with the formation of "concepts" rather than the "big ideas" of science. Rethinking in science education brought the practicing scientist into the arena of curriculum development. (Rethinking Science Education, 1959, p. 159). As scientists' participation increased and their involvement with new developments assumed these new proportions, curriculum development began to shift in the direction of principles and mechanisms of life processes. (Conference on Biological Education, 1953). Out of this background the Education and Professional Recruitment Committee was brought into existence by the American Institute of Biological Sciences. This resulted in a program known as the Biological Science Curriculum Study, (Thompson, 1970, p. 27). The framers of the Biological Science Curriculum Study indicated that more evolution should be taught in high school biology classes because it serves as a great unifying theme for all of the sciences. Today, the influence of BSCS biology is manifest in almost every biology textbook in the United States. Evolution is taught as the only scientific concept of the origin of living things for students to consider in these curricula.

Thus, there was little doubt left in the minds of students taking biology regarding the question of the origin of living things; evolution was the only scientifically acceptable mechanism. There was also little doubt regarding the motivation stimulus for a counter thrust by creation scientists. The creationists viewed this apparent monopoly as being unfair as well as being unscientific in its explanation for the phenomena of life, its origin, and its processes.

Position Papers and Letters

An examination of various position papers and letters in both education and scientific journals has shown a divergence of views in this matter. Evolutionists of strong faith are saying that creation is a religion and should not become a part of science curricula in the public schools. Thomas J. Cleaver emphasizes this view and the position of the Biological Science Curriculum Study group in his letter to the editor of the National Association of Biology Teachers.

> We must not fail to communicate our faith, nor allow those of little faith to destroy our prerogatives. Religion belongs in the churches. Science belongs in the schools. (National Science Teachers, 1971, p. 300).

Conversely, the whole subject is viewed differently from a

creationist point of view. John N. Moore comments on the question regarding whether evolution or creation should be taught:

> However, since men do attempt answers to questions of "origins" of the universe and matter, of life in animal and plant forms, of man, of his language and culture, and since science teachers insist upon exploring "origins" and first causes with their students, then science teachers seemingly should be duty bound in academic freedom and responsibility to present BOTH. . . .(Moore, 1970, p. 115)

There seems to be an emergence toward the middle ground by some educators and this middle ground is taking the shape of a two-model, evolution and creation, non-sectarian approach to curriculum and instruction as it relates to the origin of life. In a paper delivered to the Society for the Study of Evolution, just such a suggestion was made:

> Is it reasonable to suggest that students should have the same opportunities that you and I have? Isn't it in keeping with the best spirit of science to allow students to view new data, reevaluate the old and decide, based upon their best reasoning, which model these data fit the best? (Bliss, American Institute of Biological Science, 1970)

While this reflects only a summary of the kinds of papers and letters that have been written on this question both pro and con, nevertheless it seems that whoever does the writing is the one that claims neutrality and objectivity in purpose. Few in the extreme positions report a plan that would suggest both mod-

els for origins should be taught, yet survey literature tells an interesting tale about what the middle-of-the-road majority of parents would prefer to see in the public school classroom.

Random Surveys and Questionnaires

Numerous surveys have been taken related to the question of evolution and creation and its method of treatment within the classroom. It is important to this research to note the results of some of the random surveys carried out and published by interested groups. These data, shown in Appendix B, show distinctly that a majority of persons, when asked questions about evolution and creation being taught, prefer either creation or both evolution and creation to be taught in the public schools.

A coordinated study in Del Norte County Unified School District, California, by Louis R. Goodgame titled "A Critique for Teaching Various Views on the Origin of Life and the Universe in Public Schools," became available in September, 1976. This study brought forth much information directly related to the question in our present study. The parent involvement in this study presents a new dimension to the classroom and origins and is a necessary addition to the literature search. The following data

were collected in the Goodgame study (Appendix B):

1. Del Norte County Unified School District

In 1973, a survey of 1,346 homes was made which represented about 40 percent of the children attending public school. Responses to the questions were as follows:

"Should evolution be taught in the public schools?"

58%	Yes
34%	No
8%	Undecided

"Should creation be taught in the public schools?"

89%	Yes
8%	No
3%	Undecided

A. Basic Poll Coverage

1) Total of 1,346 homes contacted

2) Total of 1,537 children in these homes attending public school

B. Homes of people attending a church

1) Total of 809 homes professed church attendance

2) Questions:

a) "Should evolution be taught in the public schools?"

a) cont'd.

54% Yes

39% No

7% Undecided

b) "Should creation be taught in the public schools?"

91% Yes

6% No

3% Undecided

C. Homes of people not attending a church

1) Total of 537 homes contacted

2) Questions:

a) "Should evolution be taught in the public schools?"

64% Yes

27% No

9% Undecided

b) "Should creation be taught in the public schools?"

85% Yes

11% No

4% Undecided

2. Cupertino Union School District

In 1974, a poll of 1,995 homes was made by the Citizens for Scientific Creation. Responses to the questions were as follows: "Should scientific evidence for creation be presented along with evolution?"

84.3%	Yes
7.8%	No
6.3%	Uncertain
1.6%	Neither

It is also interesting to note that data published and collected by the Institute for Creation Research, Midwest Center, as reported over a tri-state area, seem to support the California data (Appendix B). The questions in the random telephone survey that generated these data ask whether evolution only, creation only, both evolution and creation or neither evolution or creation should be taught in public schools. The results were:

09%	Evolution only
16%	Creation only
70%	Creation and Evolution
05%	Neither Creation or Evolution

While none of these studies were national in scope the value of training teachers in both models of origins seems quite clear

from the general public's point of view.

Related Doctoral Studies

A thorough search of literature brought forth no studies directly related to the creation - evolution model approach to the origin of life; however, two very important studies by Wesley C. Barrow and Cornelius John Troost were found. These studies revealed evidence impinging on the BSCS inquiry approach to biology and factors influencing the teaching of origins that are indirectly related to this study. Pertinent information from the two studies follows:

Wesley C. Barrow conducted a study of "A Comparison of Concept and Principle Learning About Organic Evolution Between Tenth Grade Students in a Biological Sciences Curriculum Study Course Versus a Course in Traditional Biology". (Barrow, 1971). The hypotheses tested in this study were:

1. There is no difference in achievement of concept learning about organic evolution among tenth grade biology students with average or above ability in a Biological Science Curriculum Study Yellow Version course versus a course in traditional biology.

2. There is no difference in achievement in principle learning about organic evolution among tenth grade biology students

with average or above ability in a Biological Science Curriculum Study Yellow Version course versus a course in traditional biology.

3. There is no significant correlation between achievement in concept learning about organic evolution and science aptitude among tenth grade biology students with average or above average ability in the Biological Sciences Curriculum Study Yellow Version course.

4. There is no significant correlation between achievement in principle learning about organic evolution and science aptitude among tenth grade biology students with average or above ability in a Biological Sciences Curriculum Study Yellow Version course.

5. There is no significant correlation between achievement in concept learning about organic evolution and science aptitude among tenth grade students with an average or above ability in a course in traditional biology.

6. There is no significant correlation between achievement in principle learning about organic evolution and science aptitude among tenth grade students with average or above ability in a course on traditional biology.

An analysis of the data reported in the Wesley C. Barrow study revealed:

1. No significant difference in the comparison of concepts achievement with different methods of instruction, a BSCS course versus a traditional biology course.

2. A significant difference in the comparison of principles achievement with different methods of instruction. Data analysis revealed significantly higher principles achievement in the BSCS experimental group.

3. Significant correlations between concept and principle achievement and science aptitude with different methods of instruction.

It is significant to note in the Barrow study that under the conditions of the study, no significant difference in concept learning achievement occurred when average or above tenth grade students were exposed to a BSCS Yellow Version course as opposed to exposure to a traditional biology course. Significant differences occurred, however, in principles achievement when average or above tenth grade students were exposed to a BSCS Yellow Version course as opposed to exposure to a traditional biology course. It was also concluded that a significant correlation existed between concept and principle learning about organic evolution and science aptitude among the groups tested. (Barrow, Wesley C., 1971, pp. IV-V and 12).

Cornelius John Troost conducted a study titled "An Analysis of Factors Influencing the Teaching of Evolution in the Secondary Schools of Indiana" in 1966. The purpose of the study was to determine the possible significance of relationships between certain teacher and community variables and the amount of emphasis given to the subject of evolution in high school biology courses. Another aim of the study was to evaluate biology teachers with regard to what their attitudes were toward evolution and with regard to whether they seemed to misunderstand certain evolutionary concepts. In this respect, the hypotheses established in the study were as follows:

1. No significant difference will exist between large community teachers and small community teachers in their emphasis on evolution (in terms of both time spent on the subject and the amount of material covered).

2. No significant difference will exist between large and small community teachers in the extent to which they misunderstand concepts pertaining to evolution.

The following questions were formulated relating to these hypotheses:

1. Which factors are associated with the degrees of em-

phasis on the teaching of evolution?

2. To what extent is evolution being taught in the secondary schools of Indiana?

3. To what extent do biology teachers in Indiana understand evolution?

4. In what direction do possible solutions lie?

The first null hypothesis in the Troost study was rejected on the following basis:

1. There was a significant difference between large and small community biology teachers with regard to the amount of emphasis on evolution.

2. A value of 19.77 resulted from a Chi square comparison of community size with whether or not the teachers related the development of all life to evolution. This level revealed a difference which was significant beyond the one percent level.

3. There was no significant difference between large and small community teachers with regard to how much information on evolution they presented in comparison to the amount found in their textbooks; it remained that only 38 percent of the respondents claimed to teach more evolution than was in their textbooks.

4. A Chi square test which compared teacher groups according to community size with complete avoidance of the subject of

evolution revealed that no significant difference existed between the groups. Only 8.1 percent of the biology teachers reported that they totally avoided discussing evolution in the classroom.

5. Among teachers in large communities 26.7 percent taught human evolution in detail, whereas only 12.6 percent of the small community teachers did so. About 84 percent of all biology teachers in the sample did not present human evolution in detail.

The first question of the study was related to the first hypothesis. It was directed toward the kinds of variables, other than community size, which might have been associated with the amount of emphasis given to the teaching of evolution. The following results were disclosed in the Troost study:

1. Years of experience in teaching biology were independent of the amount of emphasis on the topic of evolution.

2. The amount of background (credit hours) which teachers had in biology had a significant effect (one percent level) on the amount of emphasis they gave to the topic of evolution. Of the teachers spending 15 or more days on evolution, 74 percent were those who had acquired 40 or more credit hours in the area of biology.

3. Attendance at National Science Foundation Institutes

was associated significantly with the amount of emphasis given to the teaching of evolution. Teachers with high NSF attendance spent more time on evolution than those with low attendance.

4. The use of Biological Science Curriculum Study materials was highly correlated with the amount of emphasis given to the teaching of evolution. Of the teachers who spend fifteen or more days on evolution, 66.3 percent utilized BSCS materials. Of the teachers who spent three days or less on evolution, 87.4 percent used materials other than those related to the BSCS approach.

5. There was no significant difference between Catholic and public school teachers in respect to the number of days spent on the teaching of evolution.

6. Biology teachers who had at least one course in genetics spent significantly more time (at least one week more) on the topic of evolution than those who had never taken a genetics course.

7. Teachers who claimed to have taken a course in historical geology did not differ significantly in the emphasis given to the teaching of evolution from those who had never taken such a course.

8. Self-rated religiosity was unrelated to the amount of emphasis given to the subject of evolution.

9. There was a highly significant correlation (one percent

level) between the emphasis given in general evolution and the emphasis placed upon human evolution. Among those who spent 15 or more days on general evolution, 46.4 percent taught human evolution in detail, while 63.8 percent of those who did not teach evolution in detail spent less than one week on general evolution. (Troost, p. 79).

Concluding statements in the Troost study indicate the following findings were made regarding the theological:

1. There was no significant difference between large and small community teachers in their responses to the statements.

2. About 52 percent of all respondents believed that man was the ultimate goal of evolution.

3. Approximately 54 percent of all the respondents believed that a supernatural agency is involved in the evolutionary process.

4. Over 73 percent of the total group of teachers accepted the word "purpose" when that word was associated with the word "adaptation."

A series of statements designed to expose attitudes which devalue evolution resulted in these findings:

1. There was no significant difference between large and small community teachers with regard to depreciatory attitudes.

2. Only 34 percent of the small community teachers and 33 percent of large community teachers considered evolution to be a fact.

3. Almost 46 percent of all respondents preferred to see evolution taught in an advanced course.

4. Only 12.4 percent of all respondents strongly believed that knowledge of evolution helps one to make more sense out of natural events.

5. Of all respondents, 61 percent believe that evolution cannot be a theory and a fact at the same time.

6. The majority of both groups believed that evolution should be discussed at times other than at the end of the course.

7. Over 50 percent of the respondents believed that evolution should be presented as one of several alternative theories. (Troost, 1966).

The Troost study shows the relationship between certain teacher and community factors and relates this to the amount of instructional time given to evolution while the Barrow study shows the value of inquiry in science teaching. The California and Midwest studies brought forth an additional dimension, that of social acceptance and rejection as it related to the question of social acceptance and rejection of creation and evolution. Interestingly

enough, all of these questions, as well as those related to this study, will serve to cast additional light on the strength of instructing from a two-model approach as opposed to that of a single model of evolution only.

Chapter III

METHODOLOGY AND DATA

Introduction

The desire of this study was to determine the statistical relationships between students studying the origins of living things when they had two models to choose--creation and evolution-- as opposed to students that studied evolution only. The study proposed to show whether there was any statistical differences in effectiveness between the two methods of study among students in high school biology classes. The research design chosen for this study is known as the pre-test, post-test, control group design. Internal control was maintained over the processes of data collection through computer assigned classes (random program) and all teachers involved in the experimental classes had been thoroughly inserviced in a two-model approach to the question of origins. In order to strengthen this control, the basic text and teacher's guide, Origins - Two Models, Evolution and Creation, by Bliss were used. The control group was taught the normal traditional material from the basic text, Biology: Living Systems, by Oram, Hummer, and Smoot, and the

instructor for this class did not have inservice training in a two-model approach.

The Study Design

The Pre-Test Phase:

The pre-test phase consisted of a criterion-referenced test involving concepts and mechanisms related to origins of life (Appendix A). The concepts were chosen from both evolution-oriented and creation-oriented materials. This test was in multiple-choice form for ease in conversion to data processing cards. Blanks were also provided next to the multiple choice so that hazy questions and misunderstandings could be clarified by the test taker. The test was given approximately one week before the instructional phase. Face validation was determined to be an adequate criterion for the utilization of the test instrument. In this regard, the testing instrument was sent to Dr. John N. Moore at Michigan State University for evaluation among his colleagues and students; Dr. Gary Parker, Chairman of the Biology Department at Christian Heritage College; Miss Jane Gordon, Director of Science, Racine Unified Schools; and Miss Joan Bennett, Mr. Erwin Forgy, Mr. John Sullivan, all of whom are biology teachers in the Unified School District of Racine, Wisconsin. All persons

made input to the testing instrument; final corrections were made and the test was administered to the students. Twenty-seven questions were administered and the selection of questions was made to balance creation and evolution type responses. Neutral, factual type questions were also used. A Likert type preference scale (Appendix A) was administered along with the pre-test and the post-test to determine the extent of correlation with preconception and criterion reference within groups.

The Instructional Phase:

The instructional phase of the study included the use of the student edition of Origins: Two Models - Evolution and Creation and the correlating teacher's guide and transparencies by Bliss. The course of study was based upon an inquiry approach to origins with the thematic question: "Which model do these data seem to fit best?" The teacher was cast in the professional role of unbiased factual resource person and guide to interpreting difficult concepts. A very important part of the instruction lay in the deliberate lack of commitment by the instructor to review the data and indicate which model these data seemed to fit best.

All teachers participating in the experimental group had at least three hours of graduate workshop training through the University of Wisconsin extension program in a two-model approach

to origins. Mr. Murray, who conducted the control group, has had over 21 hours of graduate training in BSCS evolutionary studies at the University of Colorado in Boulder. Teachers were aware of the necessity of using an inquiry frame for instruction in both experimental and control groups. Experimental teachers were also requested to adhere closely to the teacher's guide lesson plans, stressing inquiry and nonsectarianism, for Origins: Two Models - Evolution and Creation. Students in the experimental group went through several stages in their instruction: 1) the introductory stage, where they were appraised of both models in a nonsectarian context; 2) the project awareness stage where each group had to select a particular project to investigate in depth from a two-model approach; 3) the library research stage where members of the various groups researched available data relating to their topic; 4) the critical analysis stage where the group takes a critical view of the data to determine which model the data seem to fit best, all students within the group not having to agree with the interpretation that the majority placed upon the data; 5) the reaction panel stage where students discuss their finds and interpretations with the class as a whole; 6) the formal paper stage where the students submit, in writing, a short paper with their own analysis of the data as well as their conclusions

relating to the two models. Students were encouraged to believe that critical thought is a desirable thing in science studies and that all things are open to question.

The Post-Test Phase:

The post evaluation for both the criterion-referenced test and Likert preference scale was given within two days after the three week (15-day) session was completed. Both the control and experimental groups took the post-test during the same time period. Considering the immediacy of testing after terminating the unit, it was felt that maximum retention should be visible in both experimental and control groups. It should also be possible to see if there had been any change in preference on the Likert scale during this three week period.

Treatment of the Data

The initial data of this study consisted entirely of the responses of students to a pre- and post-criterion referenced test and a pre- and post-Likert preference type inventory. The data were collected from the students answer sheets and placed on data cards for IBM sorting and preliminary analysis. The following data were collected:

1. Raw score on pre- and post-test for both experimental and control groups.

2. Raw score frequency on pre- and post-test for both experimental and control groups.

3. Raw score percentile on pre- and post-test for both experimental and control groups.

4. Raw score standard deviation on pre- and post-test for both experimental and control groups.

5. Mean score on pre- and post-test for both experimental and control groups.

6. Raw score of girls on pre- and post-test for both experimental and control groups.

7. Raw score of boys on both pre- and post-test for both experimental and control groups.

8. A t-test of significance between pre- and post-test for both experimental and control groups.

The more sophisticated comparisons were made through the use of the University of Wisconsin computer system. The data were computed and compared as follows:

1. A t-test of significance was applied to determine if there was a significant difference between the control and experimental groups in concept development and cognitive skills as

judged by a face-validated criterion-referenced test.

2. The degree of significance of difference, in experimental and control groups, between boys and girls when both are instructed in concepts of origins.

3. The degree of significance of difference, in experimental and control groups, between low IQ students (79 through and including 102) and middle IQ students (103 through and including 112) when both are instructed in concepts of origins.

4. The degree of significance of difference, in the experimental and control groups, between middle IQ students (103 through and including 112) and high IQ students (113 through and including 146) when both are instructed in concepts of origins.

5. The degree of significance of difference, in experimental and control groups, between the Likert preference scale and concept development, cognitive skills, high IQ and middle IQ ranges when both are instructed in concepts in origins.

The control group in this study was comprised of 70 students from Mr. Darrell Murray's biology classes as Park High School in Racine, Wisconsin. The experimental groups were comprised of 119 students from three separate biology teachers' classes. Miss Joan Bennett at Park High School, Mr. Erwin Forgy at Case High School, and Mr. John Sullivan at Case High School, all in Racine,

Wisconsin.

The academic background of the four teachers involved in this project included three with masters degrees and one with the bachelor degree. All participants have strong majors in science and education. Three of the participants have over 10 years of teaching experience in science; two prefer the evolution model personally, one is indifferent to either model and one prefers creation.

Chapter IV

STATISTICAL ANALYSIS AND INTERPRETATION OF THE DATA

Introduction

The problem of this investigation was to determine if there was a significant difference in achievement on a criterion-referenced instrument between students studying evolution only in a normal inquiry manner and those studying both evolution and creation from a two-model approach. The group studying evolution only from a traditional inquiry approach constituted the control group and those studying both evolution and creation from a two-model approach constituted the experimental group. The approach to the problem was made by a method called the pre-test, post-test, control group design. Using this method on gain scores and pre-test, post-test comparisons between experimental and control groups, we were able to determine the following:

Statistics and Interpretation of Data

Tables 1 and 2 indicate the statistical relationships of the experimental and control groups in general. It was significant

TABLE 1

Experimental and Control Group Achievement Means

Group	Test	Mean	Standard Deviation	N
1. Control	Pre.	12.14	3.06	70
2. Control	Post	12.53	3.56	70
3. Control	Gain	0.39	3.31	70
4. Experimental	Pre.	11.72	3.01	119
5. Experimental	Post	15.65	3.83	119
6. Experimental	Gain	3.93	3.97	119

TABLE 2

A Comparison of Experimental and Control Group Achievement Means.

Group Comparisons	*t*-value	Level of Significance
1 and 4	0.92	none
2 and 5	5.52	.001
3 and 6	6.25	.001

to this study to note the t-value of the comparison between control and experimental group pre-tests (1 and 4). A nonsignificant value seemed to indicate that the initial state of knowledge in both groups was statistically equal. A further comparison was shown in the IQ scores of the experimental and control groups. (Table 3)

Here we found that both groups were statistically the same in basic IQ. This in turn added to our confidence in the randomness of our experimental and control group samples.

Various additional comparisons and correlations were made during this study that related to hypotheses 1 through 6 as stated in the null form. Regression analysis which included a correlated matrix of variables was used as a statistical device (Table 4). The term regression is applied to the general problem of prediction and is a shortened form of regression toward the mean in prediction. The general idea is that given any value x of X, the best linear prediction of Y is one relatively nearer the mean of Y than is x to its mean. By "relatively nearer" we mean nearer in terms of standard deviations. In simpler terms, if we standardize x and the predicted value $\hat{y}$, the resulting standardization value of $\hat{y}$ will be nearer to zero than the standardized value of x (Fig. 1).

TABLE 3

Comparison of I Q Scores

	Mean	Standard Deviation	N
Control	107.59	11.47	70
Experimental	107.89	13.06	119
t - value	0.16;	significance	none

TABLE 4

Correlation Matrix of Variables Included In the Regression

	Pre-test	I Q	Sex	Likert scale pre-test	Treatment
Pre-test	1.0				
I Q	.275	1.0			
Sex	- .019	-.037	1.0		
Likert pre	.027	.052	.127	1.0	
Treatment (two model)	- .057	.030	.045	.136	1.0
Post-test	.332	.478	- .058	.112	.394

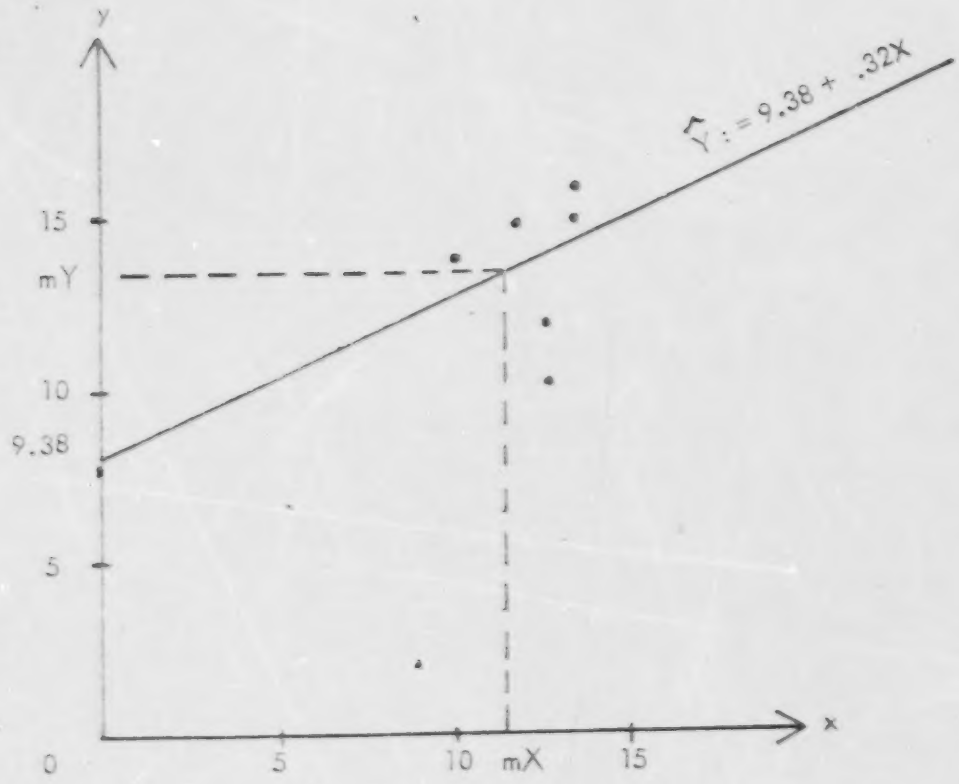

Figure 1. Scatter Diagram and estimated sample Regression Line

This study deals with more than one independent variable in order to predict a particular dependent variable, and the term used in this case is called multiple regression analysis of data or just regression when more appropriately applied.

Table 5 indicates an R^2 change of .162 when IQ is added to the regression after the pre-test. This in turn indicates that IQ accounts for 16.2 percent of the variance in gain scores, a statistically significant amount. This also means that the students' gain score can be predicted with some accuracy from the IQ alone.

The effect of sex on achievement showed an R^2 change of .001. This indicates that when sex is added to the regression after the pre-test and IQ, that sex accounts for only 0.10 percent of the variance in gain scores when IQ is controlled. This is a statistically nonsignificant amount. (Table 6)

The effect of initial attitude on achievement showed an R^2 change of .008 when the Likert pre-test was added to the regression after the achievement pre-test, IQ and sex. This indicates that initial attitude accounts for 0.8 percent of the variance in gain scores when IQ and sex are controlled. This is a statistically nonsignificant amount. (Table7)

The effect of the treatment variable on achievement showed an R^2 change of .148 when added to the regression. This indicates

TABLE 5

Effect of I Q on Achievement Gain

Dependent valiable - post-test (N=169)

	Multiple Regression	(Regression) R^2	R^2 change	Increment F-ratio
Pre - test	.332	.110	.110	20.63*
I Q	.521	.272	.162	39.92*

TABLE 6

Affect of Sex on Achievement Gain with I Q Controlled.

Dependent variable - Post-test (=169)

	Multiple Regression	(Regression) R^2	R^2 change	Increment F -ratio
Pre-test	.332	.110	.110	20.63
I Q	.521	.272	.162	36.92
Sex (girl 0 boy 1)	.523	.273	.001	0.34

TABLE 7

The Effect of Initial Attitude Toward Concepts of Creation/Evolution (as measured by Likert scale) On Gain With I Q and Sex Controlled.

Dependent variable - Post-test (N=169)

	Multiple Regression	(Regression) R^2	R^2 change	Increment F-ratio
Pre-test	.332	.110	.110	20.63*
I Q	.521	.272	.162	36.92*
Sex (girl 0, boy 1)	.523	.273	.001	0.34
Likert Pre	.531	.281	.008	1.85

that the mean gain of the experimental group is significantly higher than that of the control group when IQ, sex and initial attitude toward creation and evolution are controlled. Treatment accounts for 14.8 percent of the variation in gain scores beyond the amount accounted for by the control variables. This is a statistically significant amount. (Table 8)

The effect of teacher variable on achievement showed an R^2 change of .007 when added to the regression. This means that the teacher variable accounted for 0.7 percent of the variation in gain scores beyond the amount accounted for by the control variables. This is not a statistically significant amount and, in fact, means that variation in the teacher variable was negligible. (Table 9)

The effect of IQ on attitude change showed an R^2 of .000. This shows that IQ accounts for none of the variance in change on the Likert scale. (Table 10)

The effect of sex on attitude change showed an R^2 of .014. This indicated that sex showed 1.4 percent of the variation in attitude change with IQ controlled. This is a statistically non-significant amount. Generally, across both treatment and non-treatment groups, boys were slightly more prone to change attitude than were girls. The change in attitude, when it did occur,

TABLE 8

Effect of Treatment (two model vs. one model instruction) on gain with I Q, Sex and Initial Attitude Toward Creation/Evolution Controlled.

Dependent Variable - Post-test (N=169)

	Multiple Regression	(Regression) R^2	R^2 change	Incremental F - ratio
Pre-test	.332	.110	.110	20.63*
I Q	.521	.272	.162	36.92*
Sex	.523	.273	.001	0.34
Likert Pre	.531	.281	.008	1.85
Treatment (two model)	.655	.429	.148	42.20*

TABLE 9

Effects of Differences Among Teachers on Gain

Dependent Variable - Achievement Post-test (N=182)

	Multiple Regression	(Regression) R^2	R^2 change	Incremental F - ratio
Pre-test	.344	.118	.118	24.10*
I Q	.518	.268	.150	36.71*
Treatment (two model)	.650	.422	.154	47.47*
Teacher (Case-Park)	.655	.429	.007	0.65

TABLE 10

Effects of I Q on Attitude Change (as measured by Likert scale)

Dependent Variable - Likert Post-test (N=161)

	Multiple Regression	(Regression) R^2	R^2 change	Incremental F - ratio
Likert pre.	.632	.399	.399	105.63
I Q	.632	.399	.000	0.00

tended to be toward the high end of the Likert scale, i.e., toward more acceptance of creation concepts. (Table 11)

The effect of treatment (two models) on attitude change showed an R^2 of .025. This showed that treatment accounts for 2.5 percent of the variance in attitude change with IQ and sex controlled. This is a statistically significant amount, although it is not a large percentage of the variation. This, in effect, indicates that those in the two-model (experimental) classes were more likely to move toward the upper end, or more creation end, of the Likert scale than those in the control group. (Table 12)

The effect of sex by treatment interaction on attitude change shows an R^2 change of .016. This is 1.6 percent of the variance in attitude change beyond the IQ, sex and treatment. This is a statistically significant amount. This means that, so far as attitude change is concerned, the assignment to an experimental or control group had different effects by sex. Boys in the experimental group tended to move toward the high end, or more toward the creation end, of the Likert scale. On the other hand, boys in the control group moved slightly toward the low end. The change in girls attitudes was not influenced by assignment to either the experimental or control group. (Table 13 and 14)

TABLE 11

The Effect of Sex on Attitude Change (Likert scale) with I Q Controlled

Dependent Variable - Likert Post-test (N=161)

	Multiple Regression	(Regression) R^2	R^2 change	Incremental F - ratio
Likert pre	.632	.399	.399	105.63
I Q	.632	.399	.000	0.00
Sex (girl 0, boy 1)	.643	.413	.014	3.69

TABLE 12

Effect of Treatment (two Model) on Attitude Change with IQ and Sex Controlled.

Dependent Variable - Likert Post-test (N=161)

	Multiple Regression	(Regression) R^2	R^2 change	Incremental F - ratio
Likert pre	.632	.399	.399	105.63*
IQ	.632	.399	.000	0.00
Sex (girl 0, boy 1)	.643	.413	.014	3.69
Treatment (two Model)	.662	.438	.025	6.95*

TABLE 13

Effect of Sex by Treatment Interaction on Attitude Change with I Q, Sex and Treatment (two Model) Controlled

Dependent Variable - Likert Post-test (N=161)

	Multiple Regression	(Regression) R^2	R^2 change	Incremental F - ratio
Likert pre	.632	.399	.399	105.63*
I Q	.632	.399	.000	0.00
Sex	.643	.413	.014	3.69
Treatment (two Model)	.662	.438	.025	6.95*
Sex x treat. (girl 0, boy1)	.673	.454	.016	4.64*

TABLE 14

Showing the Degree of Influence
of Experimental and Control Groups on Attitudes
Between Likert Pre and Predicted Post Test

Likert pre.	I Q	Sex	Treatment	Predicted Likert Post.
	(gp. mean)			
3.0	108.2	boy	exp.	3.6
3.0	108.2	boy	control	2.8
3.0	108.2	girl	exp.	3.0
3.0	108.2	girl	control	3.0

Table 15 shows the changes in Likert ratings for the total group from pre- to post-test and can be read as follows: e.g., 17 students who selected a 1 response on the pre-test, also selected a 1 response on the post-test, while 16 who selected 1 on the pre-test selected a 2 on the post-test or became less evolution-oriented.

The Likert change table for the control group on both the pre- and post-tests shows a Chi Square significance level that is highly significant. This indicates a significant change in preference by the control group from the pre- to the post-test.(Table 16).

The Likert change table for the experimental group on both the pre- and post-test shows a Chi Square significance level that is highly significant. This indicates a highly significant change in preference from the pre- to the post-test for the experimental group.(Table 17)

At this point it is important to point out that the eleven-question Likert test was divided into five representative groups for ease in computer programming and general interpretation. The question groupings were made as follows:

TABLE 15

Showing the Changes in Likert Ratings for the Total Group from Pre to Post-Test

Likert Pre Score	1	2	3	4	5
1	17	16	0	8	1
2	1	16	1	9	2
3	1	2	0	0	0
4	2	5	0	35	4
5	2	5	1	5	34

Likert Post Score

TABLE 16

Showing the Changes in Likert Ratings for the Control Group from Pre to Post-Test.

Likert Pre Score					
1	10	6	CELL COUNT TOO SMALL	3	0
2	1	4		2	1
3	---CELL COUNT--			----TOO SMALL---	
4	1	2		12	1
5	2	2		0	7
	1	2	3	4	5

Likert Post Score

TABLE 17

Showing the Changes in Likert Ratings for the Experimental Group from Pre to Post-Test.

Likert Pre Score					
1	7	10	--CELL COUNT TOO SMALL--	5	1
2	0	12		7	1
3	--CELL COUNT--			--TOO SMALL--	
4	1	3		23	3
5	0	3		5	27
	1	2	3	4	5

Likert Post Score

Original question number		New question number
1		
2	----------	1
3		
4	----------	2
5		
6	----------	3
7	----------	4
8		
9		
10	----------	5
11		

When examining the data derived from the Likert distribution we find two very interesting results. The control and experimental (1 and 4) pre-test showed a t-value of 1.79 which is not significant. This would indicate that both groups were about equal in their views toward evolution and creation. On the other hand, the post-test gave a t-value of 3.10 which is significant. This seems to indicate that the experimental treatment had an effect upon the post-test.(Table 18)

The t-values for the Likert means on the post-test of both experimental and control groups, as reported by subtests, shows that there is no significance at the 0.05 level or better for low and middle and low and high IQ students. There was a significant

TABLE 18

Likert Question Analysis

	Mean	Standard Deviation	N
1. Control Pre	2.85	1.61	70
2. Control Post	2.81	1.50	70
3. Control Gain	0.04	----	
4. Experiment Pre	3.28	1.57	119
5. Experiment Post	3.48	1.38	119
6. Experiment Gain	0.20	----	
	t-value	Significant	Level
1 and 4	1.79	----	
2 and 5	3.10	.01	

difference between the middle and high IQ experimental boys. The t-value in this case was at .001 level or better. This seems to indicate that if there is a significant gain in means on the Likert scale that this gain will most probably be reported among high IQ students.(Table 19)

The t-values for the achievement means on the post-test of both experimental and control seem to indicate that the control (boys) showed no significance between low and middle IQ groups, low and high IQ groups and middle and high IQ groups.(Table 20)

The t-values for the achievement means on the post-test of the experimental group indicates that the experimental boys in the low and middle IQ groups showed a t-value that was non-significant at a level below 0.05. This was also true for the middle and high group even though this group reported 0.1, which is not significant at the 0.05 level. The low and high group showed a t-value of 7.68, which was significant at the 0.02 level, and this is highly significant.

The experimental t-values for the girls means showed a similar pattern in significant and nonsignificant gains. The low and middle groups were reported as nonsignificant as was the middle and high groups. The low and high groups showed a level that was highly significant with a t-value of 6.76 and sig-

TABLE 19

t - values for Likert Means on Post-Test
Broken Down into Subgroups.

	t - value	Significance
Control (boys)		
Low and Middle I Q	0.687	-----
Low and High I Q	1.95	-----
Middle and High I Q	3.96	-----
Control (girls)		
Low and Middle I Q	0.25	-----
Low and High I Q	0.89	-----
Middle and High I Q	2.85	0.05
Experimental (boys)		
Low and Middle I Q	1.50	-----
Low and High I Q	0.511	-----
Middle and High I Q	5.47	0.001
Experimental (girls)		
Low and Middle I Q	1.96	-----
Low and High I Q	1.10	-----
Middle and High I Q	2.93	0.01

TABLE 20

t - values for Achievement Means on Post-Test
Broken Down into Subgroups

	t-value	Significance
Control (boys)		
Low and Middle I Q	.837	- - - -
Low and High I Q	1.55	- - - -
Middle and High I Q	1.17	- - - -
Control (girls)		
Low and Middle I Q	.687	- - - -
Low and High I Q	5.87	0.05
Middle and High I Q	3.95	0.1
Experimental (boys)		
Low and Middle I Q	3.41	- - - -
Low and High I Q	7.68	0.02
Middle and High I Q	3.67	0.1
Experimental (girls)		
Low and Middle I Q	2.67	- - - -
Low and High I Q	6.76	0.02
Middle and High I Q	3.65	0.1

nificant at the 0.02 level.

These data seem to indicate that the low and high IQ group will most probably show a significant increase in means under normal conditions. The low and middle and middle and high groups will most probably show a nonsignificant increase in means. On the other hand, one could generally expect the experimental group to show a more significant change in mean scores than the control group.

Hoyt Reliability

The criterion instrument used to determine achievement was face validated by experts who were both evolutionist and creationist oriented; however, this is not a statistical method for validating a test. On the other hand, validity in itself is the degree to which the test serves the purpose for which it is intended. Seeing that creation, as a criterion, is a relatively new concept for science classes to deal with, we determined that a Hoyt Reliability test should be computed on the subtests. The reliability data were taken from the total group results on the post-test and the test itself was divided into three artificial subtest divisions, one for the evolution items, one for the creation items and one for what was considered general (fact or assumption) items. The arrange-

ment related to the total test was as follows:

I. Evolution Model Items:

(A)	(D)	(K)
(B)	(F)	(N)
(C)	(I)	(O)

II. Creation Model Items

(E)	(L)	(Q)
(G)	(M)	(R)
(H)	(P)	

III. General Items (fact or assumption)

(J_1)	(J_4)	(J_7)
(J_2)	(J_5)	(J_8)
(J_3)	(J_6)	(J_9)
		(J_{10})

The Hoyt Reliability data on subtests was taken from the total group results on the post-test which discriminated among the items as follows based on the Hoyt reliability of .64: 1) evolution items .52; 2) creation items .27 (lowest reliability); 3) general items .46. A general score of .64 or better is considered significantly reliable. This test gives us some clue to the degree of difficulty as well as internal consistency of the instrument. It is reasonable to expect creation concepts to be less familiar and thus more likely to be less formally operational. The evolution concepts would have been integrated into the structure of biological studies and thus become more familiar to the students; in this respect then, one must consider the stem quality of the

test as well as the clarity of the distractors in raising the internal consistency of the referenced instrument.

Subtest achievement scores were collected on evolution model items, creation model items and general items. _t_-values were obtained in order to determine the level of significance.(Table 21)

The value for _t_ (2.13) showed that there was a significant difference between the pre-test of the control group and the pre-test of the experimental group on the evolution subtest. This is difficult to explain as both groups should have had an equal exposure to evolution at the time of the pre-test. The post-test, on the other hand, shows a _t_-value of 4.45 and is significant at the .000 level. It is assumed that treatment had some influence on this score, but it would not be expected to influence the score by this amount as the control group was studying evolution during the same period that treatment (two models) was in progress. It seems that the experimental group did better on evolution items than did the traditional group that was concentrating on evolution.

The results of the subscore on the creation model items shows a _t_-value of 0.84 on the pre-test (1 and 4) for control and experiment which seems to indicate that both groups knew about the same amount of material on the pre-test (Table 22). The post-test for the control and experimental groups shows a _t_-value of

TABLE 21

Results of Subtest Scores on Evolution Model Items

	Mean	Standard Deviation	N
1. Control (pre)	3.93	1.37	70
2. Control (post)	4.33	1.66	70
3. Experimental (pre)	3.45	1.51	119
4. Experimental (post)	5.54	1.87	119

	t - value	Significant Level
1 and 3	2.13	.05
2 and 4	4.45	.001

TABLE 22

Results of Subscores on Creation Model Items

	Mean	Standard Deviation	N
1. Control (pre)	2.81	1.22	70
2. Control (post)	3.03	1.33	70
3. Experimental (pre)	2.97	1.29	119
4. Experimental (post)	4.11	1.51	119

	t - value	Significant Level
1 and 3	0.84	------
2 and 4	4.93	.001

4.93 which is significant at the .001 level. Of course, the control group would not be expected to do as well on creation items, since they did not study these concepts at all. Notice, however, that the time spent on creation concepts did not hinder the learning of evolution concepts, since the experimental group strongly out performed the control on the evolution subtest (Table 21).

The results of the subtest scores on general items in the pre-test (1 and 4) show a t-value of 0.32 which is nonsignigicant (Table 23). This means that both groups had about the same knowledge of the general items when they took the pre-test. This score was expected; however, the post-test (2 and 5) showed a t-value of 2.74 which is significant at the .01 level. These items dealt entirely with critical thought, i. e. the ability of students to discriminate between empirical data (herein called "facts") and non-empirical ideas (herein called "assumptions," but including inferences, hypotheses, and other lines of argument subject to more than one interpretation). The experimental group did significantly better on these items.

Null Hypothesis (H_O)1: Table 1 and 2 show the pre- and post-test gains between the control and experimental groups. These data seem to indicate that the basic hypothesis H_O1, stated in its null form, will be rejected. The comparison of experimental

TABLE 23

The Results of Subscores on General Items

	Mean	Standard Deviation	N
1. Control (pre)	5.40	2.12	70
2. Control (past)	5.17	2.23	70
3. Experimental (pre)	5.30	1.99	119
4. Experimental (past)	6.00	1.79	119
	t - value		Significant Level
1 and 3	0.32		- - - -
2 and 4	2.79		.01

and control (comparisons 2 and 5) show a t-value of 5.52 which is significant at the .001 level. Gain score comparisons of experimental and control (comparisons 3 and 6) show a t-value of 6.25 which is significant at the .001 level. These data seem to indicate that there is a significant difference in concept development and cognitive skills between students taught from a single-model vs. two-model approach.

Null Hypothesis (H_O)2:

Table 6 and 19 show that there is no significant difference between boys and girls when both are instructed in concepts in origins from a two-model approach and in an inquiry context. In view of this we can accept null hypothesis (H_O)2. This seems to indicate that boys and girls will do as well in both the control or the experimental group; however, boys and girls will both do better in the experimental group than in the control group. This is corroborated in Table 8 where the effect of treatment on gain, with IQ, sex and initial attitude toward creation and evolution controlled is shown.

Null Hypothesis (H_O)3:

Table 19 shows that there is no significant difference between low and medium IQ groups which include both boys and girls in control and experimental groups. In view of this we can accept the

null hypothesis (H_O)3 in total.

Null Hypothesis (H_O)4:

Table 19 shows that there is a significant difference between both boys and girls when comparing the experimental low and high IQ groups, with the exception of the boys in the control group. In view of this we can accept (H_O)4 in part.

Null Hypothesis (H_O)5:

Table 19 shows that the t-values between the middle and high IQ groups are high but not significantly high for both boys and girls in the experimental group and are insignificant for the boys in the control group. In view of this we can accept the null hypothesis (H_O)5.

Null Hypotheses (H_O)6 through 9:

Tables 7, 15 and 18 show that there is no significant difference between the Likert preference scale and concept development and cognitive skills, high IQ and low IQ and middle IQ ranges between students taught from a two-model approach and those taught from a single-model approach. Students in the experimental group however, showed significant gains in means on the Likert scale as shown in Table 18. In view of this, we can accept the null hypothesis in part and reject that part demonstrated in Table 18 group 2 and 5.

Chapter V

SUMMARY CONCLUSIONS AND RECOMMENDATIONS

Summary of Study

Within the last decade the whole concept of science instruction has centered around the inquiry approach. Researchers have gathered data that show many satisfying by-products in reading, language arts, and logical thought. An inquiry approach centers around a presentation of data by the teacher through reading and via experimentation. These data are then acted upon by the students from a logical framework. This, of course, means that the role of the teacher now includes the form of a professional, skilled in questioning techniques, rather than simply a disseminator of all knowledge. Inquiry, in its best context, never reflects a teacher bias, but rather, is objective and develops logical thought and decision-making skills among students.

The purpose of this study was to determine if a two-model -- evolution and creation -- approach to the origin of life on the one hand, and a traditional approach (evolution only) on the other, both of which were inquiry oriented, would show significant differences

in favor of one or the other as a basic instructional method.

While the study brought forth data that are very useful to the classroom teacher, it also suggests a solution to a controversy that is presently belaboring education. It seems as though both creation and evolution are the preference of parents polled in various parts of the United States (Appendix B). These parents seem to reject the idea of either creation or evolution being taught as the only model. In addition to this, the Troost study pointed to data indicating that over 50 percent of the teachers thought that evolution should be taught as one of several alternative theories.

In our study we found, through research in the literature, an indication that a basic understanding of the methods of science will enable the student to adapt and improvise to meet the needs of particular situations and to be less dependent upon the results of others. (Phenix, 1964, p. 333). Furthermore, it was shown that a student should be actively engaged in the education process if the student is going to have an operational understanding of the concepts being developed. (Renner and Lawson, 1973, p. 166).

Another aspect of the study centered around the use of process skills in science. In this respect it seemed as though the experiment would be inclined to reinforce skills such as: using rational

processes, learning how to learn, how to attack new problems, how to acquire new knowledge, building competence in basic skills, etc. In addition, the National Science Teachers Association stated that: "Above all, the school must develop in the individual an ability to learn under his own initiative and an abiding interest in doing so. The goal of science education should be to develop scientifically literate citizens with necessary intellectual. . . skills to promote the development of man as a rational human being." (National Science Teachers Association, 1971, p. 47). One could assume from this that study by means of a two-model approach (both models meeting the criteria for a scientific model) would be far more likely to meet the guidelines set forth by educational leadership throughout the country. It seems that we have, in fact, suggested a mind-stimulating approach to the study of the origin of living things which meets the needs of the day.

Summary of Hypotheses

All hypotheses in this study were stated in the null form in order to facilitate acceptance or rejection indicated by statistical significance.

The First Hypothesis:

There is no significant difference in concept develop-

ment and cogritive skills between students being taught from a two-model approach, and those being taught from a single-model approach (evolution only).

The first null hypothesis centered around concept development and cognitive skills between students being taught from a two-model approach (experimental) and those being taught from the traditional evolution or single-model approach (control). When these were compared statistically, we discovered that the t-value was significant in favor of rejecting the first null hypothesis at the .001 level. This, of course, is the major hypothesis under study.

The Second Hypothesis:

> There is no significant difference between boys and girls when both are instructed in concepts of origins from a two-model approach; neither will develop significantly better cognitive skills related to origins of living things than those instructed from a single-model approach.

The second null hypothesis dealt with the achievement of boys and girls as they related to experimental and control groups. In this respect we found that there was no significant difference in achievement gain between boys and girls. In fact, our study showed 0.1 percent of variance in gain scores, which indicates in favor of accepting the second null hypothesis.

The Third Hypothesis

> There is no significant difference between low IQ students, 79 through and including 102, and middle IQ students, 103 through and including 112, when both are instructed in concepts of origins from a two-model approach; neither will develop significantly better cognitive skills related to origins of living things than those instructed from a single-model approach.

The third null hypothesis dealt with low and middle IQ students achievement between the pre- and post-test. We found that low and middle IQ boys showed a significant difference at the .01 level; the low and middle IQ girls, on the other hand, showed significant difference at the .05 level. The levels of significance indicate in favor of rejecting the third null hypothesis.

The Fourth Hypothesis:

> There is no significant difference between low IQ students, 79 through and including 102, and high IQ students, 113 through and including 146, when both are instructed in concepts of origins from a two-model approach; neither will develop significantly better cognitive skills related to origins of living things than those instructed from a single-model approach.

The fourth null hypothesis dealt with low and high IQ students achievement between pre- and post-test. We found that both the low and high IQ boys and girls showed a significant difference at the .001 level. This is very significant and indicates in favor of rejecting the fourth null hypothesis.

The Fifth Hypothesis:

> There is no significant difference between middle IQ students, 103 through and including 112, and high IQ students, 113 through and including 146, when both are instructed in concepts of origins from a two-model approach; neither will develop significantly better cognitive skills related to origins of living things than those instructed from a single-model approach.

The fifth null hypothesis dealt with middle IQ and high IQ students. We found that both boys and girls with middle and high IQ showed a difference in achievement at the .01 level. This is a significant difference and indicates in favor of rejecting the fifth null hypothesis.

The Sixth Hypothesis:

> There is no significant difference in Likert preference and concept development and cognitive skills between those taught from a two-model approach and those taught from a single-model approach.

The sixth null hypothesis dealt with Likert preference and concept development and cognitive skills. We found that the R^2 change indicated initial attitude accounted for only 0.8 percent of the change in concept development and cognitive skills (Table 7). This is an insignificant amount and thus indicates in favor of the null hypothesis.

The Seventh Hypothesis:

> There is no significant difference in Likert preference

and low IQ and middle IQ students between those taught from a two-model approach and those taught from a single-model approach.

The seventh null hypothesis dealt with Likert preference and IQ. We found that between low and middle IQ boys there was no significant difference (t-value 1.50), but there was a .1 level of significance in the same group with girls (t-value of 1.96). Since this is not significant at the .05 level, we felt justified in favoring the acceptance of the seventh null hypothesis.

The Eighth Hypothesis:

There is no significant difference in Likert preference between low IQ and high IQ students between those taught from a two-model approach and those taught from a single-model approach.

The eighth null hypothesis dealt with performance on the Likert scale between students in the low and high IQ range. We found that neither the boys nor the girls showed a significant difference between these ranges; therefore, the hypothesis is accepted.

The Ninth Hypothesis:

There is no significant difference in Likert preference between middle IQ and high IQ students, between those taught from a two-model approach and those taught from a single-model approach.

The ninth null hypothesis dealt with performance on the Likert scale between students in the middle and high IQ groups. Here we found a t-value of 5.47 for the boys which was very sig-

nificant at the .001 level. We also found that the t-value for the girls in this range was 2.93 and significant at the .01 level as reported in Table 19. These data strongly indicated in favor of rejecting the ninth null hypothesis.

Conclusions

The strong rejection (.001) of null hypothesis number one provides the answer to the central problem addressed in this work. Do differences in cognitive skills and concept development appear between groups taught from a two-model vs. evolution only approach to origins? The answer is clearly yes. Although there was no significant difference initially between these groups on the pre-test and other criteria, the results showed that the experimental (two-model) group gained more in cognitive skills and concept development.

By statistically breaking up the groups and by examining Likert preferences, statements concerning several subsidiary hypotheses can also be made. In summary, the data seem to indicate that between the middle and high IQ groups we can expect to find a significant change at the .05 level or better with boys and girls in both the experimental and the control groups. Table 19 also seems to indicate that a change toward

the creation end of the Likert Scale will be greater between the middle and high IQ students in the experimental groups than in the control groups, with members of the high IQ group showing the greater gain. The table also suggests that the boys in both the experimental and control groups will show a greater change than will girls.

In addition to the direct testing of the nine hypotheses we were able to correlate a matrix of variables by using multiple regression techniques (Table 4). These data showed significance in the effects of IQ on achievement gain (Table 5) and again in the effects of treatment (two models) on gain (Table 8).

Other comparisons were made that were important to this study. One of them, shown in Table 9, was that the teacher variable had a negligible effect upon the study.

Table 10 indicated that IQ had no effect upon the attitude change of the students in this study. This is significant to the study when we consider the data in Table 5 which show that IQ had a significant effect upon achievement gain.

Another factor of interest is reflected in Table 11. These data show that boys are more inclined to show a change in attitude than girls, and that when this change of attitude does occur the change will tend to be in the direction of creation.

The effect of treatment (two models) on attitude change, reflected in Table 12, showed that treatment accounted for a statistically significant amount of variation in attitude change, and showed that those in the two-model classes were more likely to move toward the higher end (more creation) of the Likert Scale.

Tables 13 and 14 show the effects of sex and treatment interaction on attitude change. Boys in the experimental group tended to move toward the high end of the Likert Scale (more toward creation) and boys in the control group tended to move (slightly) toward the low end of the scale (more toward evolution). On the other hand, the change in girls' attitudes was not influenced by assignment to either the experimental or control groups, as shown in Table 14.

Tables 15, 16 and 17 related entirely to the Likert ratings for the total group, the control group, and the experimental group. Chi Square analysis showed that there was a significant change in the control group (Table 16) and a highly significant change in the experimental group (Table 17) from pre- to post-test. When data were examined from the Likert question analysis (Table 18), we found that the post-test comparison showed a t-value that was significant. This seemed to indicate that the experimental treatment had an effect upon the post-test.

In addition to this, we were able to break down the questions on the criterion-referenced test into evolution, creation and general questions in order to run a Hoyt reliability test on the items. While our results showed that this test needed additional work to lower its level of difficulty and thus strengthen internal consistency, the results were, nevertheless, not too surprising. We could understand how new concepts, especially those of creation, would tend to be hard to interpret in a written form. As a criterion-referenced instrument, however, this would seem to have less effect on the outcome of the data than would a normative instrument, which, of course, seeks to establish a normal curve.

With this testing instrument, criterion-referenced, we were able to get sub-test scores in the three categories. Table 21 shows the results of the scores on evolution model items. The data indicate that, even while there was a significant difference in the pre-test, which is difficult to explain, the post-test showed a highly significant gain for the experimental group. The control group had studied evolution concepts only, both prior to and during the experimental period, so they would be expected to turn in the higher scores on the evolution part of the test. But in spite of this, the experimental group did

significantly better. We can only conclude from this that learning about both evolution and creation helped students to grasp evolution better.

Table 22 shows the results of the scores on creation model items. The data seem to indicate that there is a highly significant difference between the post-test of the control and that of the experimental. This is not a surprising gain as the control group was not exposed to creation concepts.

Table 23 shows the results of the scores on the general items of the test. Here we found that the experimental group, once again, showed significant gains when the post-tests of control and experimental groups were compared. As these items dealt entirely with critical thought, it is reasonable to conclude that the experimental group exercised a more critical frame of reference. It seemed that they were willing to challenge the premise upon which the evolution and the creation models were based and thus, we can conclude, were significantly more objective in their viewpoint. As this is generally thought to be inherent in the inquiry approach it should not be too surprising to see these data expressed. Perhaps a more important aspect of these data is that taking a one-model approach to origins does not tend to develop critical thought among students

nearly as well as contrasting two-models does.

Implications

The numerous data in this study comparing a two-model approach with a single-model approach clearly suggest what one can expect in the classroom. It seems that the students will be inclined, through study of two-models, to be better observers, better interpreters of data, better formulators of questions and new hypotheses. They may be inclined toward experimental data and have an understanding of the importance of examining alternative models or paradigms in scientific studies. In addition to this, their own research will tend to enable them to learn how to learn. These, then, are some of the skills that we can expect to come from a two-model oriented study of origins.

We should also be able to expect certain value transfers such as: respect for logic, search for the meaning of data, a basic longing for knowledge and understanding, a consideration of consequences, a consideration of premises, a demand for verification and a questioning mind toward all things. This approach is intrinsically honest and fair and, in turn, should promote honesty and fairness in the student.

A two-model approach to the origins of living things should not include sectarian religion for the public schools; the approach should place its emphasis only on the interpretation of scientific data presently available. A two-model approach, in essence, is significant only when students have had an opportunity to hear, see, and read about pertinent data relating to topics on the origins of living things. When students have had this opportunity to make these observations and evaluate the data from their level of understanding, then a teacher might ask them to determine which model, if any, the data seem to fit best. Educators must recognize how important this is to the academic freedom of young minds.

Recommendations

On the basis of the results of this study and considering the problems in the study, we can make the following recommendations:

1. The criterion-referenced instrument used in this study should be re-evaluated as to the difficulty of stem construction and modified where needed in order to establish a greater internal consistency (Hoyt reliability) for the instrument and to eliminate any possible bias.

2. This study should be replicated in other school dis-

tricts throughout the country, in order to test its greater validity and to verify the findings herein.

3. Further experimentation with the two-model approach to the study of origins needs to be conducted in both the sciences and social sciences. It is conceivable that topics in anthropology and sociology will lend themselves to productive instruction from this approach.

4. This study suggests that there is considerable pedagogical merit in a two-model approach, especially in a democratic and pluralistic society. If further research verifies and extends these findings, many doors of instructional innovation will be opened. For example:

a. Alternative published curricular materials can be made available to schools in which the scientific method is applied to diverse bodies of substantive knowledge, such as creation and evolution and their various approaches to the origins of life.

b. The National Science Foundation could be encouraged to underwrite and generally aid in the development of curricula related to a more open approach to origins of life topics.

c. Professional workshops could be conducted for all teachers and at various depths in order to improve teachers' knowledge of two-models, and their various sub-models, based on scientific data.

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APPENDIX A

CRITERION INSTRUMENTS

Student's Name_____

School_____

Teacher_____

PRE- AND POST-TEST FOR BIOLOGY STUDENTS
ON ORIGINS OF LIFE

Choose the best answer and mark an X on the blank beside it.

A. Which of the following is the most important ASSUMPTION made in the evolution model?
VOCABULARY WORD:
Assumption: Non-factual statement or idea

_____ 1. life has evolved over millions of years or more.

_____ 2. the fossil record is evidence of evolution.

_____ 3. fossils actually exist.

_____ 4. the geologic column can be found any place in the world.

_____ 5. evolution can be seen.

B. With regard to the origin of birds, what ASSUMPTION is made by evolutionists?

_____ 1. birds appeared suddenly.

_____ 2. birds originated as a freak of nature.

_____ 3. birds gradually came from reptiles that were capable of flight.

_____ 4. the change was caused by chromosomes separating.

_____ 5. natural selection produced this change suddenly.

C. Concerning the origin of flight, what ASSUMPTION is made by evolutionists?

_____ 1. Flight came about through chromosome accidents.

_____ 2. flight is basically genetic in nature.

_____ 3. flight is the result of natural selection.

_____ 4. flight is the result of a creator's design.

_____ 5. flight could not have come about by accident.

D. According to the evolution model, which of the following ASSUMPTIONS is most important?
Oxidizing: having much oxygen
Reducing: having little or no oxygen

_____ 1. the earth always had an oxidizing atmosphere.

_____ 2. the earth began with a reducing atmosphere.

_____ 3. the present oxidizing atmosphere of the earth evolved from a reducing atmosphere.

_____ 4. the earth was a molten mass at its beginning.

_____ 5. none of the above.

E. According to the creation model, which of the following ASSUMPTIONS is most important?

_____ 1. the earth always had an oxidizing atmosphere.

_____ 2. the earth always had a reducing atmosphere.

_____ 3. the present oxidizing atmosphere of the earth evolved from a reducing atmosphere.

_____ 4. the earth was a molten mass at its beginning.

_____ 5. none of the above.

F. According to the evolution model, the earth can be estimated to be very old by:

_____ 1. carbon-fourteen (C^{14}) dating.

_____ 2. uranium-lead dating.

_____ 3. the earth's magnetic decay.

_____ 4. amount of helium in the atmosphere.

_____ 5. none of the above.

G. According to the creation model, the earth can be estimated to be young by:

_____ 1. uranium-lead dating.

_____ 2. carbon-fourteen (C^{14}) dating.

_____ 3. the earth's magnetic decay.

_____ 4. all of the above.

_____ 5. none of the above.

H. Which explanation for many varieties would fit the creation model best?
Mutations: changes or alterations in a gene

_____ 1. mutations alone.

_____ 2. mutations and natural selection.

_____ 3. a large original gene pool.

_____ 4. inbreeding populations.

_____ 5. none of the above.

I. Which explanation for varieties would fit the evolution model best?

I. Continued

_____ 1. mutations alone.

_____ 2. mutations and natural selection.

_____ 3. a large original gene pool.

_____ 4. inbreeding populations.

_____ 5. none of the above.

J. To identify each of the following statements, place an "F" in the space before the number if you think the statement is a fact; or place an "A" in the space before the number if you think it is an assumption. State a reason in the blank.

_____ 1. The earth is billions of years old._____

_____

_____ 2. The earth is thousands of years old._____

_____

_____ 3. The simplest cell is very complex._____

_____

_____ 4. Homology shows evolutionary relationships._____

_____

_____ 5. Coacervates evolved into simple cells._____

_____

_____ 6. Sidney Fox's experiment shows evolution._____

_____

_____ 7. Stanley Miller's experiment shows evolution_____

_____

_____ 8. Evolutionists can trace certain features of a tiny shrewlike animal to many mammals and even man.

_____

_____ 9. Creationists use the Second Law of Thermodynamics to show that all living things tend to go from the very complex of organization to disorder and death._____

_____

Probability: the mathematical possibility of something happening.

_____10. According to the laws of probability, a protein with a given sequence of 200 amino acids would likely happen by accident once in about 10^{260} times._____

_____

K - R. Consider the statements in the following; for each mark an "E" in the blank if you think the statement would be most likely associated with the evolution model; mark a "C" in the blank if you think the statement would be most likely associated with the creation model.

Homology: parts of organisms that appear similar in structure, but not necessarily in function.

_____ K. Homology is clearly shown in the similarity between the hoof of a horse, a bat's wing, and a dog's foot; and in the similarity between a lizard's jaw bone and a mammal's ear bones. In plants, homology exists among fern sporophytes and the leaves of trees and flowers.

_____ L. The simplest cell is highly complex; it possesses over 1500 complex enzymes and carries out highly

coordinated chemical reactions that imply design.

_____ M. There are many varieties of dogs, horses, roses and ferns resulting from a large basic gene pool for each group of organisms.

_____ N. Chemicals in the original reducing atmosphere of the earth were acted upon by ultra-violet light and electrical discharges. Soon many compounds were produced and finally, the first cell appeared.

_____ O. Index fossils tell the story of life in the rocks. They can be used to identify layers of rock formation with much certainty.

_____ P. The existence of fossil graveyards in many parts of the world seems to be a definite clue to a worldwide flood.

_____ Q. All chemical systems go from the highly ordered state (complex) to a highly disordered state.

_____ R. 750,000 square miles of sediment of thousands of feet in thickness was found on the Tibetan Plateau, three miles high as a result of uplife 1000 years ago.

S. With the information you now have, which one of the evolutionary concepts seems the <u>most doubtful</u> to you? (Mark an "X" in the blank of your choice.)

_____ 1. New species or varieties could occur by being isolated (separated).

_____ 2. All life could have evolved from a single cell.

_____ 3. Man evolved from an apelike ancestor.

_____ 4. Homology is the best evidence for evolution.

_____ 5. Evolution occured by mutation and natural selection.

T. With the information you now have, which one of these creation concepts seems <u>most doubtful</u> to you?

T. Continued

(Mark an "X" in the blank of your choice.)

_____ 1. All organisms have the possibility of producing great varieties such as humans, birds, cats, rats, etc.

_____ 2. A god of creation specially designed all life on this planet.

_____ 3. At best all living things tend to go toward disorganization.

_____ 4. Probability shows evolution is very unlikely.

_____ 5. Even the simplest cell is far too complex to ever have evolved by chance.

LIKERT PREFERENCE SCALE

On the following scale we are asking you to place an "X" on the blank next to the statement that you feel comes closest to your ideas. Mark only one "X" on this sheet.

____1. Evolution is true because almost all scientists and educated people believe this.

____2. Evolution is a fact that has been proven by scientific studies.

____3. The evolution of all life seems fairly certain from scientific studies.

____4. The evolution of some living things is possible, but something else caused much of the life we see.

____5. Evolution occured with the help of God.

____6. Neither evolution nor creation is a very good idea about how life came to be.

____7. Creation started all life, but some evolution was necessary.

____8. Creation is possible, but something else caused much of the life we see.

____9. The creation of all life seems fairly certain from scientific studies.

____10. Creation is a fact that has been proven by scientific studies.

____11. Creation is a fact because God has revealed it to us.

APPENDIX B

SURVEY TABLES

QUESTION:

Should Evolution Only, Creation Only, Both Evolution And Creation or Neither Evolution or Creation Be Taught in Public Schools

Number Responding	Evolution Only	Creation Only	both	neither
6243	.09	.16	.70	.05

Random telephone surveys taken in the Midwest Chicago area. Surveys were taken by members of ICR Midwest Center, 1977.

The following survey was taken in the Del Norte County Unified School District, California.

A. Basic Poll Coverage
   1. Total of 1,346 Homes contacted
   2. Total of 1,537 children in these homes attending public school

B. Homes of people attending a church
   1. Total of 809 homes that professed church attendance
   2. Questions:
      a) "Should evolution be taught in the public schools?"

         54% YES
         39% NO
          7% UNDECIDED

      b) "Should creation be taught in the public schools?"

         91% YES
          6% NO
          3% UNDECIDED

C. Homes of people not attending a church
   1. Total of 537 homes contacted
   2. Questions:
      a) "Should evolution be taught in the public schools?"

         64% YES
         27% NO
          9% UNDECIDED

      b) "Should creation be taught in the public schools?"

         85% YES
         11% NO
          4% UNDECIDED

QUESTION:

Response to Central Question and Conviction of Respondent
Grouped by Schooling Status of Children

Status of Children	No. of responses	Yes	No	Uncertain	Neither	Creation	Evolution	Uncertain	Neither	Both
No children	621	524	49	38	16	276	144	117	70	20
	100%	84.4	7.9	6.1	1.6	43.5	23.2	18.8	11.3	3.2
Pre-school	260	233	17	8	2	111	67	42	30	10
	100%	89.6	6.5	3.1	0.8	42.7	25.5	16.2	11.5	3.8
Elementary	900	745	78	59	18	385	220	169	96	30
	100%	82.8	8.7	6.5	2.0	42.8	24.5	18.8	10.6	3.3
High School	524	440	34	39	11	243	114	104	48	15
	100%	84.0	6.5	7.4	2.1	46.4	21.7	19.9	9.1	2.9
Private school	74	68	5	1	0	51	13	4	3	3
	100%	91.9	6.8	1.3	0.0	68.9	17.5	5.4	4.1	4.1
College	213	175	11	22	5	100	39	43	22	9
	100%	82.2	5.2	10.3	2.3	47.0	18.3	20.2	10.3	4.2

The above table shows responses to the central question and conviction of respondent grouped by schooling status of children. Cupertino Union School District Appendix B-4, Table D.

QUESTION:

Should Scientific Evidence for Creation Be Presented Along with Evolution?

Number of Responses	Answer to Central Question				Conviction of Respondent				
	Yes	No	Uncertain	Neither	Creation	Evolution	Uncertain	Neither	Both
1995	1681	155	126	33	884	464	366	211	70
100%	84.3	7.8	6.3	1.6	44.3	23.3	18.3	10.6	3.5

Cupertino Union School District Appendix B-2, Table B.

QUESTION:

Should Scientific Evidence for Creation Be Presented Along with Evolution?

		Answer to Central Question				Sex of Respondent	
Personal Conviction	No. of Responses	Yes	No	Uncertain	Neither	Male	Female
Creation	884	822	32	23	7	220	664
	100%	93.0	3.6	2.6	0.8	24.9	75.1
Evolution	464	350	93	19	2	231	233
	100%	75.4	20.1	4.1	0.4	49.8	50.2
Uncertain	366	280	20	63	3	125	241
	100%	76.5	5.5	17.2	0.8	34.2	65.8
Neither	211	169	7	16	19	81	130
	100%	80.1	3.3	7.6	9.0	38.4	61.6
Both	70	60	3	5	2	20	50
	100%	85.8	4.3	7.1	2.8	28.6	71.4

The above table shows responses to the central question grouped by expressed conviction of the respondents. Cupertino Union School District Appendix B-4, Table C.

QUESTION:

Response to Central Question and Conviction of Respondent
Grouped by Schooling Status of Children

Status of children	No. of Responses	Yes	No	Uncertain	Neither	Creation	Evolution	Uncertain	Neither	Both
No children	621	524	49	38	16	276	144	117	70	20
	100%	84.4	7.9	6.1	1.6	43.5	23.2	18.8	11.3	3.2
Pre-school	260	233	17	8	2	111	67	42	30	10
	100%	89.6	6.5	3.1	0.8	42.7	25.8	16.2	11.5	3.8
Elementary	900	745	78	59	18	385	220	169	96	30
	100%	82.8	8.7	6.5	2.0	42.8	24.5	18.8	10.6	3.3
High School	524	440	34	39	11	243	114	104	48	15
	100%	84.0	6.5	7.4	2.1	46.4	21.7	19.9	9.1	2.9
Private school	74	68	5	1	0	51	13	4	3	3
	100%	91.9	6.8	1.3	0.0	68.9	17.5	5.4	4.1	4.1
College	213	175	11	22	5	100	39	43	22	9
	100%	82.2	5.2	10.3	2.3	47.0	18.3	20.2	10.3	4.2

The above table shows responses to the central question and conviction of respondent grouped by schooling status of children. Cupertino Union School District Appendix B-4, Table D